Attorney: Art Hasan
Docket No.: 42055/SAH/K415
Inventor(s): Philip J. Kellman, Ph.D.
Title: SYSTEM AND METHOD FOR ADAPTIVE LEARNING
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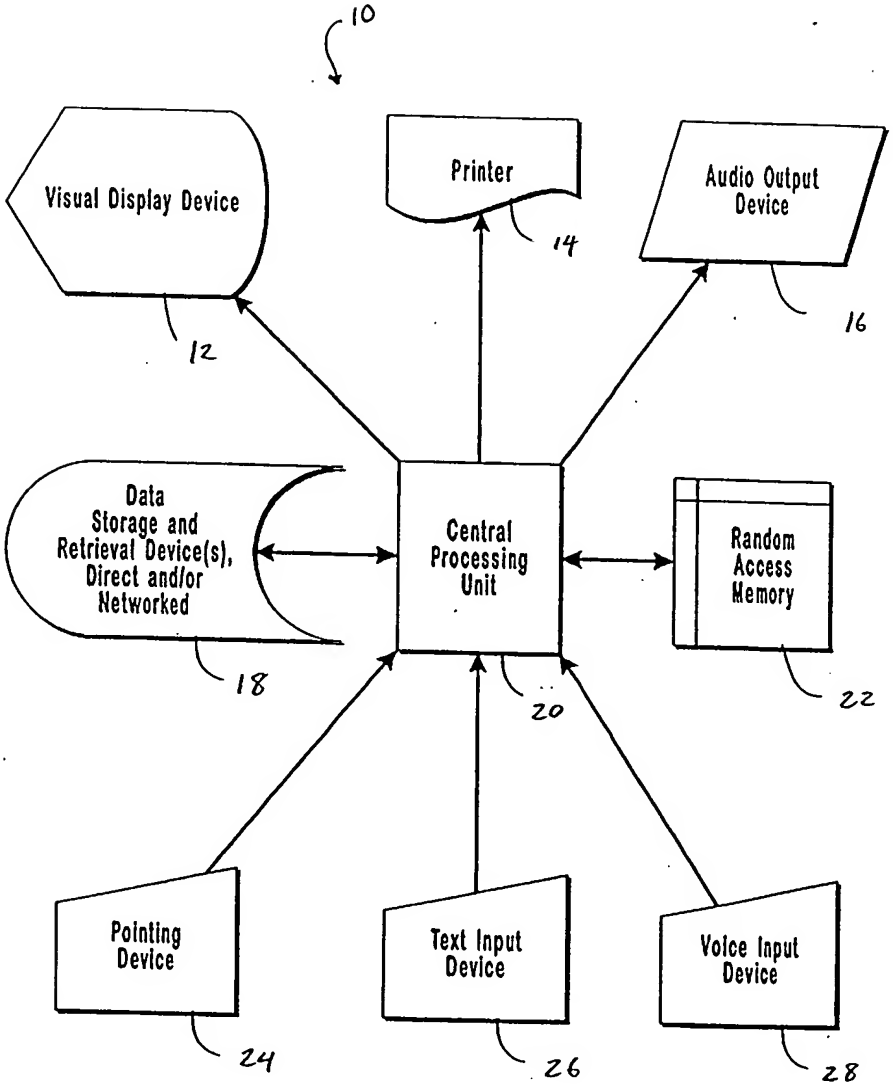


FIG. 1

(12)

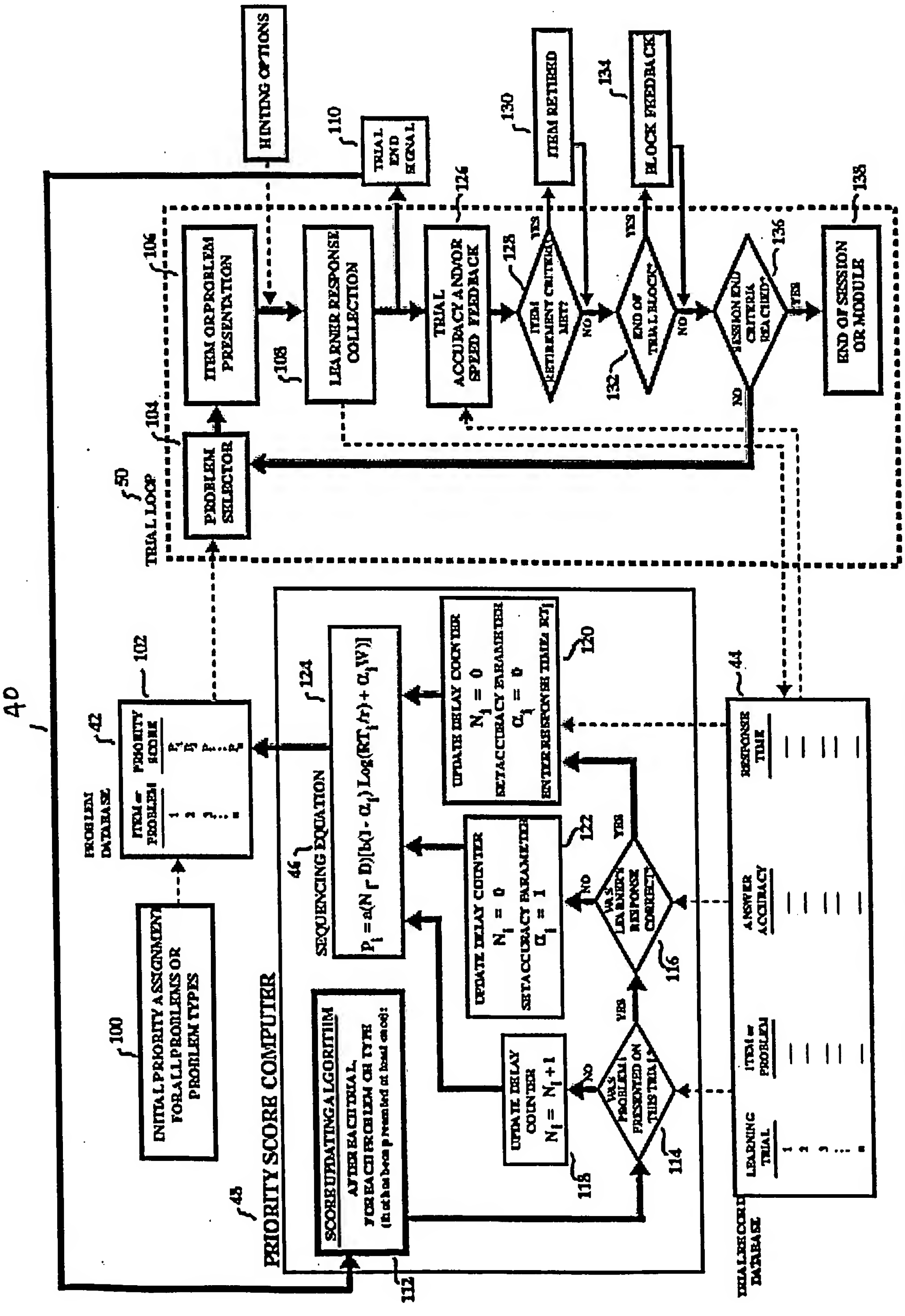
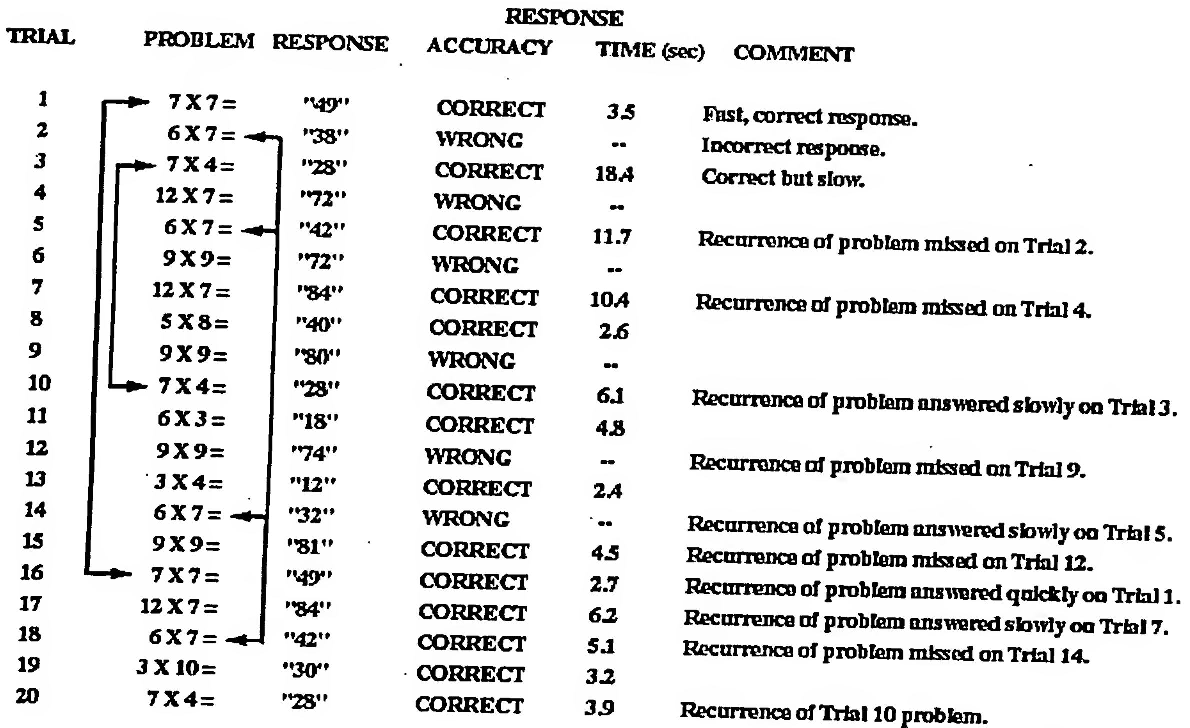


FIGURE 2. OPTIMAL SEQUENCING METHOD



TRIAL	PROBLEM	RESPONSE	RESPONSE ACCURACY	RESPONSE TIME (sec)	COMMENT
1	7 X 7 =	"49"	CORRECT	3.5	Fast, correct response.
2	6 X 7 =	"38"	WRONG	--	Incorrect response.
3	7 X 4 =	"28"	CORRECT	18.4	Correct but slow.
4	12 X 7 =	"72"	WRONG	--	
5	6 X 7 =	"42"	CORRECT	11.7	Recurrence of problem missed on Trial 2.
6	9 X 9 =	"72"	WRONG	--	
7	12 X 7 =	"84"	CORRECT	10.4	Recurrence of problem missed on Trial 4.
8	5 X 8 =	"40"	CORRECT	2.6	
9	9 X 9 =	"80"	WRONG	--	
10	7 X 4 =	"28"	CORRECT	6.1	Recurrence of problem answered slowly on Trial 3.
11	6 X 3 =	"18"	CORRECT	4.8	
12	9 X 9 =	"74"	WRONG	--	Recurrence of problem missed on Trial 9.
13	3 X 4 =	"12"	CORRECT	2.4	
14	6 X 7 =	"32"	WRONG	--	Recurrence of problem answered slowly on Trial 5.
15	9 X 9 =	"81"	CORRECT	4.5	Recurrence of problem missed on Trial 12.
16	7 X 7 =	"49"	CORRECT	2.7	Recurrence of problem answered quickly on Trial 1.
17	12 X 7 =	"84"	CORRECT	6.2	Recurrence of problem answered slowly on Trial 7.
18	6 X 7 =	"42"	CORRECT	5.1	Recurrence of problem missed on Trial 14.
19	3 X 10 =	"30"	CORRECT	3.2	
20	7 X 4 =	"28"	CORRECT	3.9	Recurrence of Trial 10 problem.

Table 1

Figure 3. Sample Sequence of Trials Using the Sequencing Algorithm. Relevant parameter values: a = .1, b = 2, D = 2, W = 12, K = 1. Arrows indicate selected examples of problem recurrence. (See text.)

PROBLEM	TRIAL 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
7 X 7 =	1	-.088	0	.088	.176	.264	.352	.44	.528	.616	.704	.792	.88	.096	1.06	1.14	.075	.151	.226	.30
6 X 7 =	1	1	-1.2	0	1.2	-.148	0	.148	.296	.444	.592	.74	.888	1.04	-1.2	0	1.2	2.4	.11	.22
7 X 4 =	1	1	1	-.2	0	.202	.404	.606	.808	1.01	-.129	0	.129	.258	.387	.516	.645	.774	.903	1.03
12 X 7 =	1	1	1	1	-1.2	0	1.2	-.158	0	.158	.316	.474	.632	.79	.948	1.10	1.26	.123	.245	.368
9 X 9 =	1	1	1	1	1	1	-1.2	0	1.2	-1.2	0	1.2	-1.2	0	1.2	.102	.204	.307	.409	.511
5 X 8 =	1	1	1	1	1	1	1	1	.07	.14	.21	.28	.35	.42	.49	.56	.63	.70	.77	.85
6 X 3 =	1	1	1	1	1	1	1	1	1	1	1	.106	.212	.318	.424	.530	.636	.742	.848	.954
3 X 4 =	1	1	1	1	1	1	1	1	1	1	1	1	1	.068	.137	.205	.273	.341	.409	.477
3 X 10 =	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	.083
8 X 4 =	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4 X 12 =	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3 X 9 =	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8 X 7 =	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11 x 5 =	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6 X 8 =	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
⋮																				

Figure 4. Priority Scores by Trial for Sample Sequence in Figure 3. Columns indicate trials; rows show a partial list of problems in the database. Circled priority scores indicate the problem chosen by the algorithm for that trial. Parameter values: a = .1; b=2; W=12; D=2; k=1; r=2

TRIAL	PROBLEM	RESPONSE	ACCURACY	RESPONSE TIME (sec)	COMMENT
1	camino	"road"	CORRECT	3.5	Fast, correct response.
2	Martes	"March"	WRONG	--	Incorrect response.
3	dos	"two"	CORRECT	18.4	Correct but slow.
4	verde	"Don't know"	WRONG	--	
5	anaranjado	"angel"	WRONG	--	
6	Martes	"Tuesday"	CORRECT	15.0	Recurrence of problem missed o
7	Abril	"April"	CORRECT	10.4	
8	facil	"easy"	CORRECT	2.6	
9	verde	"green"	CORRECT	9.7	Recurrence of problem missed o
10	anaranjado	"apple"	WRONG	--	Recurrence of problem missed o
11	Viernes	"Friday"	CORRECT	4.8	
12	azul	"blue"	WRONG	--	
13	dos	"two"	CORRECT	2.4	Recurrence of problem answere
14	Noviembre	"November"	CORRECT	8.6	
15	anaranjado	"orange"	CORRECT	11.3	Recurrence of problem missed o
16	cero	"zero"	CORRECT	2.7	
17	camino	"road"	CORRECT	6.2	Recurrence of problem answere
18	Martes	"Tuesday"	CORRECT	5.1	Recurrence of problem answere
19	hija	"daughter"	CORRECT	3.2	
20	empujar	"orange"	WRONG	--	

Figure 5. Sample Sequence of Trials Using the Sequencing Algorithm with Parameters Set to Favor Introduction of Relevant parameter values: a = .1, b = 1.5, D = 2, r=2, W = 6, K = 1.2.

PROBLEM	TRIAL 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
camino	1.2	-.09	0	.09	.18	.27	.37	.46	.55	.64	.73	.82	.92	1.01	1.1	1.19	1.25	-.09	0	.09
Martes	1.2	1.2	-0.6	0	0.6	1.2	-0.14	0	.14	.28	.42	.56	.70	.84	.98	1.11	1.25	1.39	-.08	0
dos	1.2	1.2	1.2	-0.16	0	.16	.32	.49	.65	.81	.97	1.13	1.3	-.12	0	.12	.25	.37	.49	.61
verde	1.2	1.2	1.2	1.2	-0.6	0	.6	1.2	1.8	-0.12	0	-0.12	.23	.345	.46	.58	.69	.81	.92	1.04
anaranjado	1.2	1.2	1.2	1.2	1.2	-0.6	0	.6	1.2	1.8	-0.6	0	.6	1.2	1.8	-.12	0	.12	.25	.37
Abril	1.2	1.2	1.2	1.2	1.2	1.2	1.2	-.08	0	.08	.17	.25	.34	.42	.51	.59	.68	.76	.85	.93
facil	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	-.09	0	.09	.18	.27	.37	.46	.55	.64	.73	.82	.92
Viernes	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	-0.16	0	.16	.33	.49	.66	.82	.99	1.15
azul	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	-.07	0	.07	.13	.20	.26	.33	.40
Noviembre	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	-0.11	0	.11	.22	.33	.44
cero	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	-.09	0	.09	.19
hija	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	-0.6
empujar	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
amarillo	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Lunes	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
rosado	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2

FIGURE 6. Priority Scores by Trial for Sample Sequence in Figure 5. Columns indicate trials; rows show a partial list of problems in the database. Circled priority scores indicate the problem chosen by the algorithm for that trial. Parameter values: a = .1; b=1.5; W=6; D=2; k=1.2; r=2.

FIGURE 7. PERCEPTUAL LEARNING MODULE

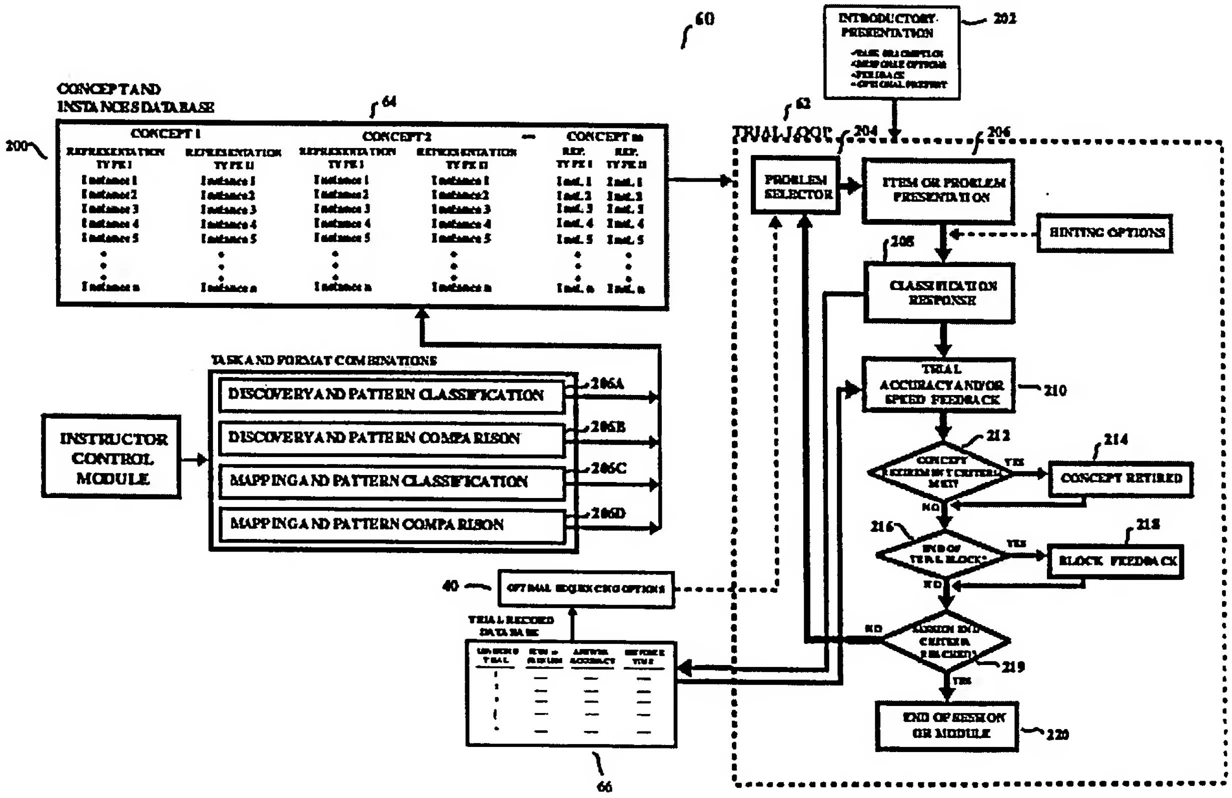


FIGURE 8. PERCEPTUAL LEARNING SYSTEM: *STRUCTURE DISCOVERY* VARIANT

PROBLEM PRESENTATION FORMATS - DETAIL

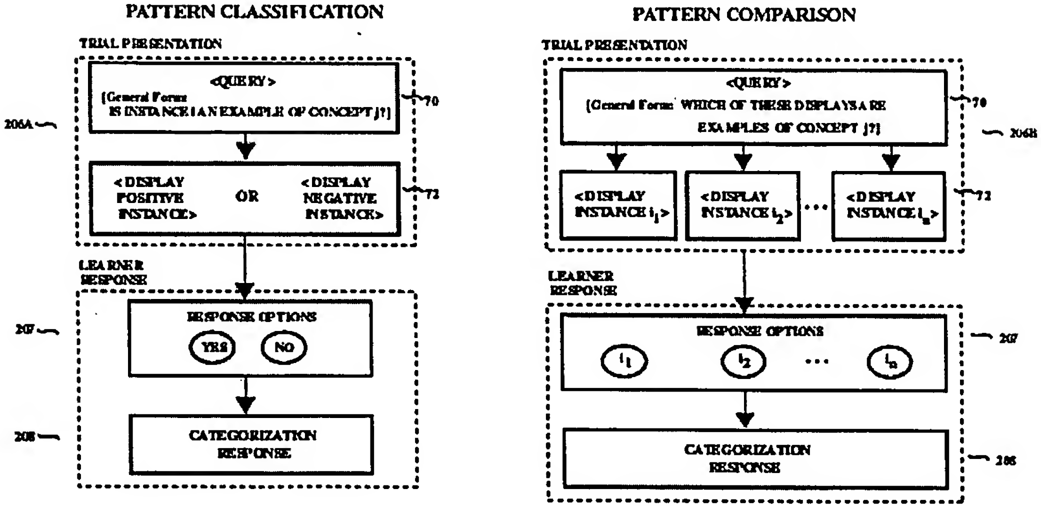


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FIGURE 9. PERCEPTUAL LEARNING SYSTEM: *STRUCTURE MAPPING* VARIANT

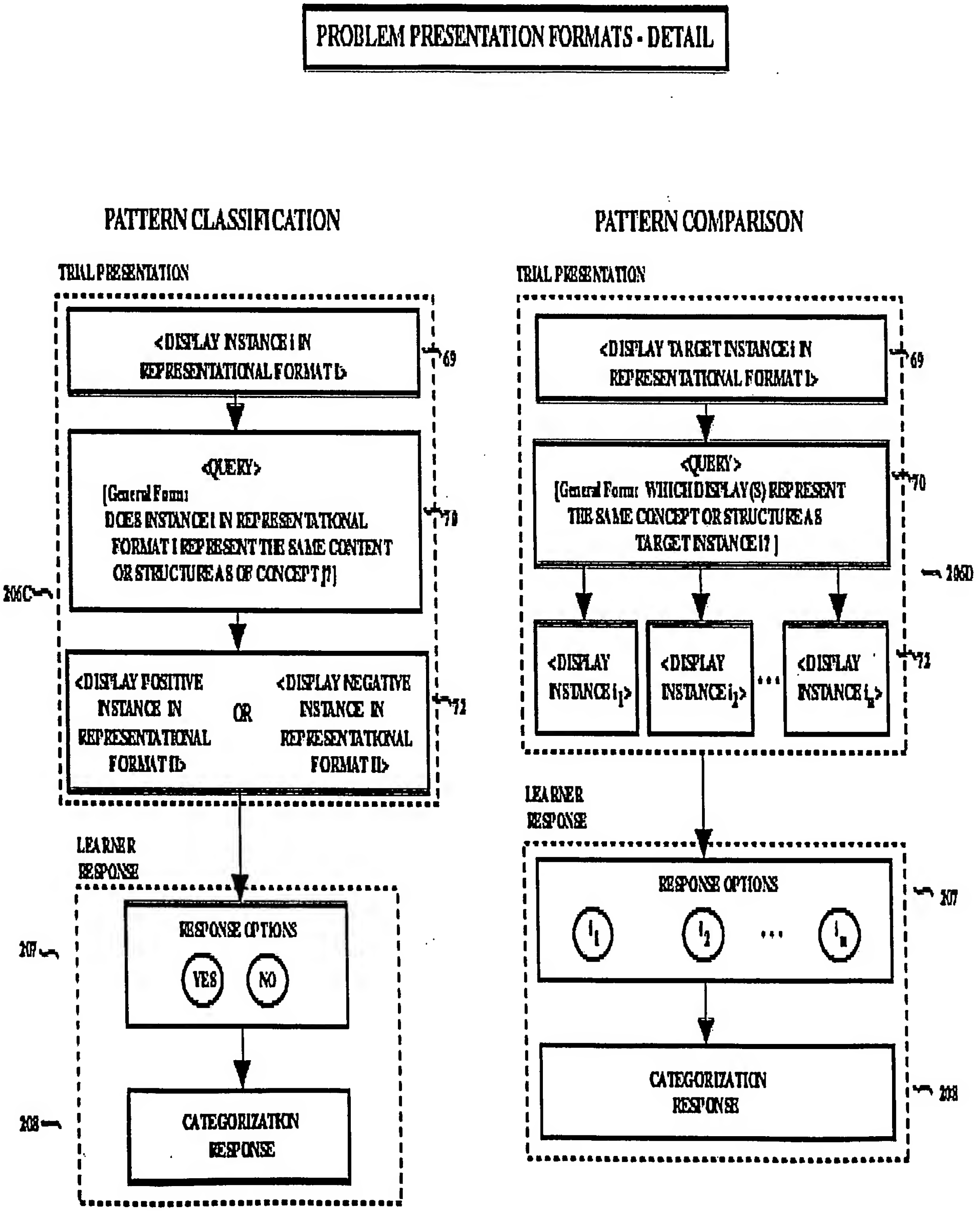
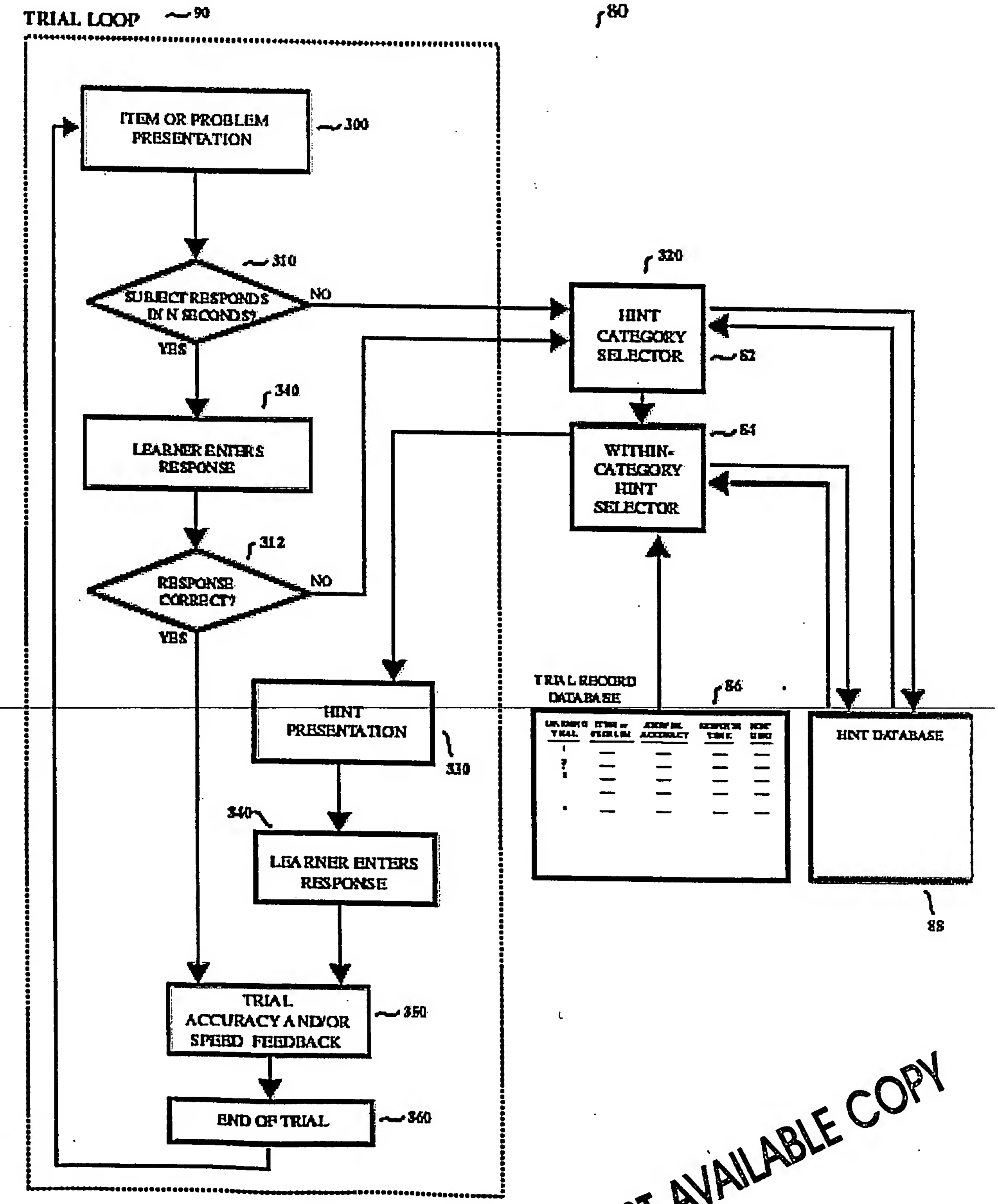


FIGURE 10

HINTING ALGORITHM: OVERVIEW



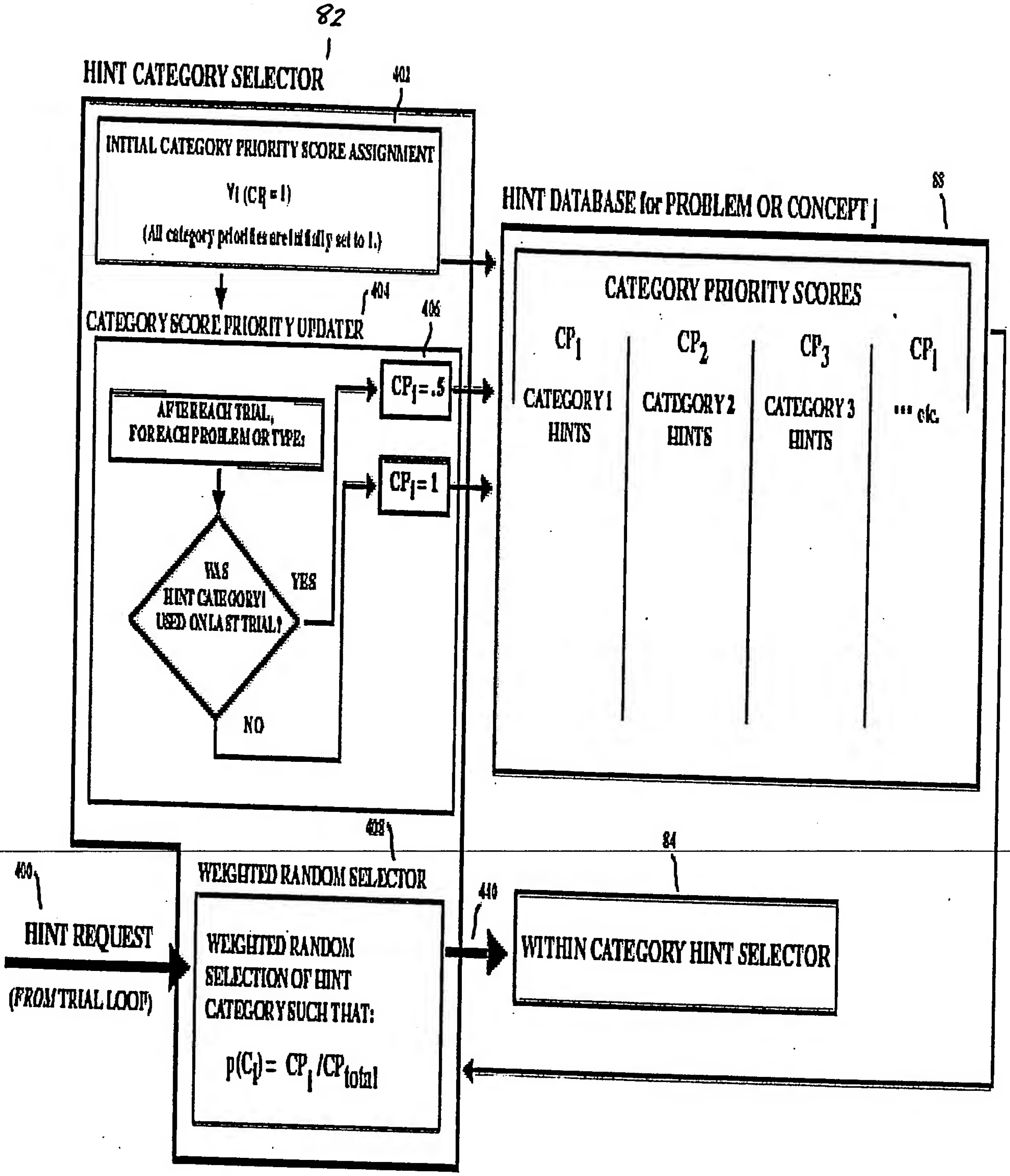


FIGURE 11. HINT CATEGORY SELECTOR

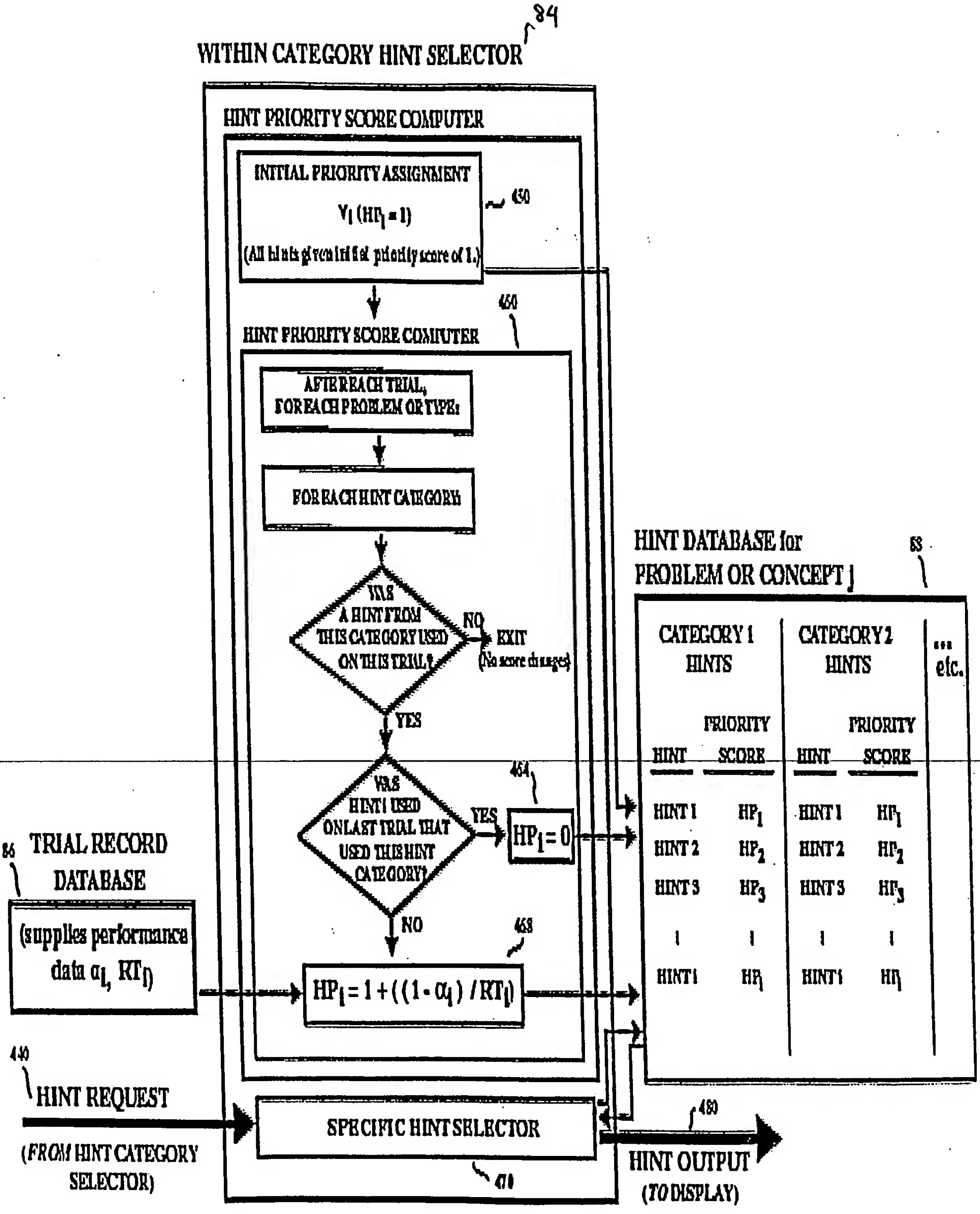


FIGURE 12. WITHIN-CATEGORY HINT SELECTOR

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